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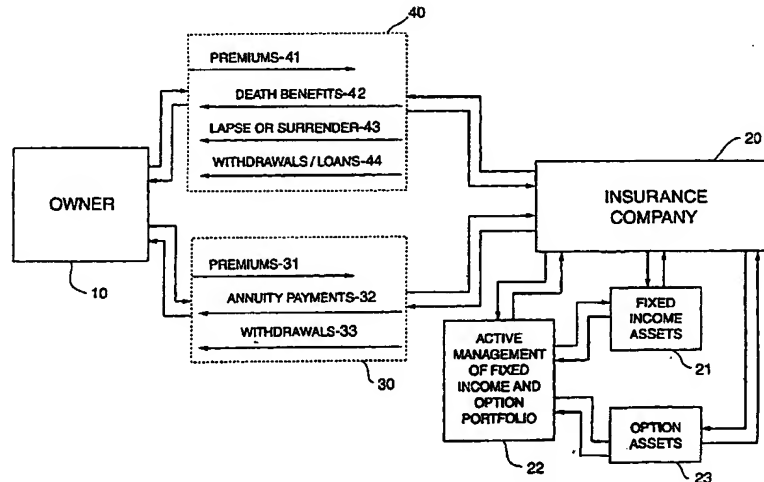
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(54) Title: **SYSTEM FOR ANALYZING AND MANAGING EQUITY PARTICIPATION LIFE INSURANCE AND ANNUITY CONTRACTS**



(57) Abstract: A system and method for analyzing and managing a plurality of specified life insurance policies (40) and annuity contracts (30) on behalf of an insurance carrier (20). The life insurance policies or annuity contracts depend on stock market performance in that the account value increase is determined as a percentage of the performance of a stock market index with set caps and floors. For a life insurance policy (40), upon the death of the insured, the insurance company (20) pays a death benefit (42) under the life insurance policy (40) to the beneficiary named by the owner. The owner (10) can also withdraw funds from annuity contract (30) or life insurance policy (40) through withdrawals (33), (44), loans (44). The percentage is adjusted according to the yield on fixed rate assets. The system provides cash and profit determinations from the life insurance policies (40) and annuity contracts (30).

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SYSTEM FOR ANALYZING AND MANAGING EQUITY
PARTICIPATION LIFE INSURANCE AND ANNUITY CONTRACTS

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FIELD OF THE INVENTION

The present invention relates to a computer system for analyzing and managing life insurance and annuities on behalf of an insurance company. More specifically, it relates to a system in which the cash values, death benefits and surrender values of the life insurance or annuity are partially related to stock market performance.

15

BACKGROUND OF THE INVENTION

Individuals often purchase life insurance which has cash value accumulation in addition to death benefits. The cash value can be withdrawn, borrowed, or received upon termination of the policy. Corporations may purchase or sponsor life insurance as a financing vehicle for benefit plan costs or other liabilities. Such policies can have beneficial tax consequences for the corporation. Similarly, deferred annuity contracts have account value buildup which can be withdrawn, received on surrender, or taken as annuity payments. Naturally, higher return rates for life insurance policies or deferred annuity contracts will increase the accumulated cash value to the benefit of the owner.

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Generally, insurance companies use two approaches for investing the premiums to provide the cash value increases

for life insurance policies and annuity contracts, general account and separate account ("variable"). Using the general account approach, a life insurance company will usually invest conservatively with an emphasis on fixed income assets such as high grade corporate bonds. Such policies offer a guarantee of principal and some minimum return, often 4%. Where a policy owner desires a higher return on cash values than afforded by these conservative investments, it may purchase a variable life policy or annuity contract. A variable life policy or annuity contract offers various investment alternatives including equities which have traditionally realized a higher return than fixed income instruments. Of course, higher rewards typically require more risk taking. Likewise, variable life insurance policies or annuity contracts have no minimum cash value guarantees. The typical life insurance company is unwilling to offer the policy owner the upside rewards of variable life while it assumes the downside risks by making guarantees of the general account type policy.

Therefore, a substantial need exists for a system which manages insurance company investments related to life insurance policies and deferred annuity contracts to potentially generate significant upside returns to the policy owner with little or no downside risk to the policy owner or insurance company.

SUMMARY OF THE INVENTION

In view of the foregoing, there exists a need in the art for a system which enables insurance companies to effectively and efficiently provide equity returns, without substantial loss risks. A need also exists for a life insurance policy, annuity contract, or other financial product which allows for improved return on investment to the owner, also without significant downside risks.

The present invention provides a life insurance policy or annuity contract which includes partial participation in stock market returns with specified caps and floors. The present invention provides a system for analyzing assets and liabilities of the insurance carrier relating to such policies and for determining the purchase and sale of options, swaps, calls or other hedging instruments to match assets and liabilities. Therefore, it is an object of the invention to provide assurances to the insurance company that the stock or equity market participation element of the life insurance or annuity can be met through conservative investments without undue risks to the carrier or policy owner.

With these and other objects, advantages and features of the invention that may become hereinafter apparent, the nature of the invention may be more clearly understood by reference to the following detailed description of the invention, the appended claims and to the several drawings attached herein.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block flow diagram showing investment organization according to a preferred embodiment of the present invention.

FIG. 2 is a block flow diagram of the insurance product according to a preferred embodiment of the present invention.

FIG. 3 is a block flow diagram of the analytical system for analyzing assets and liabilities according to a preferred embodiment of the present invention.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

Referring now in detail to the drawings wherein like parts are designated by like reference numerals throughout, there is illustrated in Fig. 1 a life insurance policy 40 and annuity contract 30 according to the preferred embodiment of the present invention. A policy owner 10 pays premiums 31, 41 to an insurance company 20. For an annuity contract 30, upon completion of the term, the owner receives annuity payments 32. For a life insurance policy 40, upon the death of the insured, the insurance company 20 pays a death benefit 42 under the life insurance policy 40 to the beneficiary named by the owner 10. The owner 10 can also remove money from the annuity contract 30 or life insurance policy 40 through withdrawals 33, 44, loans 44, or surrender 43 wherein the policy 40 is terminated and the account value, less any surrender charges, is

returned to the owner 10. Death benefits 42 are described below, but annuity payments 32, withdrawals 33, 44, loans and surrender payments 43 may also be made depending upon the reason for termination of the policy -- death of the insured, end of term, loan, withdrawal, or surrender by the owner 10.

The death benefits 42 and cash values depend on stock index performance as discussed further below. Typically, an insurance company invests in fixed income assets 21 in order to provide the necessary return on investment to meet liabilities, including death benefits, withdrawals or surrender payments. Since under the present invention the death benefit 42 and cash value depend on stock index performance, fixed income assets may be insufficient to meet liabilities. Therefore, the insurance company can either (1) actively manage a fixed income and option portfolio 22, or (2) manage a fixed income portfolio 21 and purchase an option which closely or exactly matches the liability risk 23. In addition, an insurance company could self-insure for the investment risk, or actively manage a stock portfolio. However, these last two possibilities are not viable alternatives for typical insurance carriers, and are not contemplated under the present invention.

Fig. 2 is a block flow diagram illustrating operation of an insurance product which is the subject of the present invention. Premiums are paid at step 110. By way of example, a \$40,000 single premium policy with an assumed average issue age of 45 would apply to a death benefit face amount of approximately \$125,000. From the premium,

mortality and administrative charges are deducted periodically at step 120.

5 The performance of the policy is determined by a participation rate based upon increases in a stock market index such as Standard & Poor's 500 Index ("S&P Index"); To provide additional flexibility of performance, return can be based upon participation in other stock or financial indices, such as the Japanese Nikkei index, the German DAX
10 index, the Canadian TSE 300 index, currency indices, treasury rate indices, and fixed rate indices. The floor rate is credited to the account value throughout the year at step 125. The return is adjusted on a yearly basis at step 130 with respect to the beginning of year account
15 value. Of course, the premiums could be paid and cash values could be adjusted on other than a yearly basis. The participation rate is multiplied by the increase in the S&P Index to determine an annual participation amount at step 130, subject to the set cap and floor. The account value
20 of the policy is determined yearly, at step 150, by increasing the previous year's account value by the participation amount. In addition, there may be guaranteed cumulative returns, determined at step 140, to meet state regulatory requirements. The account value is recalculated
25 yearly at step 160 based upon the greater of the stock market participation, including caps and floors, or the cumulative guaranteed rate.

30 Cash values and death benefits are then calculated with respect to the current account value. Death benefits are calculated in a known manner which complies with 26

U.S.C. § 7702 to qualify as life insurance. The cash value and death benefit determination 170 is used to calculate the liabilities for the insurance company, as discussed below. If the insured dies (or the policy is terminated) during any annual period, determined at step 180, the insurance company pays the death benefit 200 (or surrender amount). Also, any withdrawals reduce the cash value.

For an annuity contract, premiums are paid and the cash values are calculated in a manner similar to the life insurance policy.

Fig. 3 is a block flow diagram and discloses a system for the insurance company to manage assets and liabilities in order to meet the cash values and death benefits owed on policies of the type illustrated with respect to Fig. 2. Preferably, the system is implemented on a digital computer including a CPU and various memories. Typically, insurance companies have a mainframe computer or mini-computer for performing other functions which can be used in the present system.

Premiums 300 are paid into total assets 340 and death benefits 310 are paid from total assets 340. The computer stores in memory information about the assets, such as the amount and characteristics of cash, options, bonds, and other investments.

A portion of the assets 341 is invested in fixed rate investments 390. The remainder of the assets are invested in options to hedge the risk from the stock index related

performance of the liability. Alternative methods for hedging risks such as swaps, calls and reinsurance can be used in place of or in conjunction with options.

5 The Black-Scholes formula, or other option pricing formula, is used to determine expected option costs in determining necessary hedging and pricing. The Black-Scholes formula provides an option cost based upon index price, exercise price, option term and assumptions of
10 risk free rates of return, average dividend yield, and volatility of returns (standard deviation of returns). Since the life insurance policy has floor and cap rates of return, the option price is based upon the difference between the option price for the floor rate of return and
15 for the cap rate of return.

For example, with a fifty percent participation rate, return of premium floor (0%), 10% cap return, a one year risk-free rate of 4%, an S&P 500 dividend yield of 3%, and
20 a standard deviation of S&P returns of 15%, the option cost would be 2.65% of premium. Other premium related expenses for the product, i.e. mortality and administrative charges, are approximately 1.7% of premium. Thus, 95.65% of the premium remains to be invested in fixed assets. A return
25 on fixed assets of 4.55% is sufficient to meet the return of premium floor.

Periodically, the system determines and compares the assets and liabilities to monitor hedges 500 and to
30 determine appropriate investments, both for options and for fixed assets. Both assets and liabilities are interest and

stock price sensitive. Insurance companies typically use a process for matching assets and liabilities with respect to interest rate changes. These processes can be used with respect to the fixed asset investments. The Black-Scholes formula, as discussed above, is used to value option risks in pricing and monitoring assets and liabilities.

The death benefits and cash values, as defined at step 170 of Fig. 2, are calculated for all policies according to the formula previously given and summed to determine the total liability 350 for all policies then in force. The assets 340 and liabilities 350 are compared at step 360 to determine whether they are appropriately matched relative to stock price changes. If the asset sensitivity to stock price changes is less than the liability sensitivity to stock price changes, then options are purchased at step 361 to hedge the liability risk. If asset sensitivity is greater than liability sensitivity then options can be sold at step 362 to again match the risk.

The purchase and sale of options is used to hedge against changes in stock prices. However, the possible impact of interest rate changes must also be considered. The insurance company's existing asset and liability matching system can be used to appropriately invest in fixed assets to hedge interest rate changes. Theoretically, both assets and liabilities are valued through stochastic simulation. Multiple interest rate scenarios are generated to project behavior of assets and liabilities and present value the results. This is a very computation-intensive approach. If non-exotic assets are

used, i.e., ordinary fixed assets such as high-grade corporate bonds, then a simpler deterministic approach is sufficient. One deterministic approach could be to use duration and convexity matching, which are well known.

5 Alternatively, key or partial duration matching could be used, which calculates price changes resulting from shocks to interest rates at key term points on the yield curve, such as 1 year, 10 year and 30 year rates. Fixed assets are purchased or sold to match interest rate sensitivities

10 for assets and liabilities.

The asset portfolio is managed to keep the sensitivities close to targets determined by the investment strategy. By periodically monitoring and matching the

15 risk, the insurance company can maintain profits and meet death benefit (or surrender value) liabilities. As part of these hedging activities, the system also shows changes in market values of assets, liabilities and economic surplus per point change in the S&P 500 Index or other index and

20 per basis point change of interest at key or partial durations, to assess the effectiveness of hedging operations.

The system also determines the net cash flow and profit at step 370. Net cash flow and profits depend upon

25 premiums 300 received, death benefits 310 paid, purchases 361 and sales 362 of options, and any gains on fixed rate investments 390.

30 Periodically, the participation rate is adjusted in order to keep earnings as stable as possible. The

accumulated profit on the block of assets is compared with the target accumulated profit. If the actual profit exceeds the target, then the participation rate is increased for policies with anniversaries falling within the period. If actual profitability is less than target, then the participation rate for new issues and rollovers will be decreased.

The initial pricing and subsequent annually determined participation rate and any corresponding caps are adjusted and depend directly upon the yield of fixed income investments 390 in the insurance company's portfolio. Average book yield can be used for restricted liquidity products, but new money yield should be used for greater liquidity products to prevent investment antiselection. Therefore, as the fixed income yield 391 increases so does the participation rate of the policyholder. The participation rate and cap rate are determined according to the following formula:

$$1 = E + OC(\text{participation rate, participation cap}) + 1/(1 + Y)$$

where:

E is a percentage of premium expense factors;

OC is the cost of the equity participation option based on the rate and cap; and

Y is the yield on fixed income instruments with a maturity equal to that option.

E is initially set to the product expenses (expressed as a level percentage of premium), and the rate and cap are determined for different interest rate levels as described above. E is then adjusted and the equation re-solved at different interest rates to achieve the desired profit results. Table 1 below illustrates example participation rates and cap rates for given yields.

TABLE 1

Yield	Participation Rate	Cap Rate
5%	22%	8%
6%	35%	10%
7%	46%	12%
8%	55%	14%
9%	63%	16%
10%	69%	18%
11%	73%	20%
12%	77%	22%

The participation rate is used in determining the estimated death benefits as part of the liabilities. Changes in the participation rate are selected so that earnings are kept fairly stable without large fluctuations in the participation rate. Expected investment income and expected policy credit over an accounting period, as determined by the system, provides feedback on the

effectiveness of the rate setting process and a guide to future rate setting.

Through periodic determination of assets and liability
5 and the purchase and sale of appropriate options to match
the liability risks, the insurance company is protected
from the risks resulting from a volatile stock market. The
policy owner 10 also is provided with increased equity
participation in a life insurance policy with limited
10 downside risks.

Although a preferred embodiment is specifically
illustrated and described herein, it will be appreciated
that modifications and variations of the present invention
15 are covered by the above teachings and within the purview
of the appended claims without departing from the spirit
and intended scope of this invention.

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What is new and deemed to be protected by Letters Patent in the United States is:

1. An insurance policy computer system that
5 administers a plurality of equity related life insurance policies on behalf of an insurance company, said computer system comprising:

premium collection means for collecting premiums for each of said plurality of life insurance policies;

10 account value means for determining a respective account value for each of said plurality of life insurance policies, wherein said account value is determined with respect to increases in stock prices;

15 death benefit determining means for determining a death benefit amount for each of said plurality of life insurance policies relative to said account value; and

hedge monitoring means for controlling stock price fluctuation risks, said hedge monitoring means including:

20 asset determining means for determining the value of assets from said premiums and from investment returns on investments;

liability determining means for determining the value of liabilities relative to said account values and death benefits;

25 investing means for investing in at least one of fixed rate assets and options; and

30 control means for comparing said assets and liabilities relative to changes in stock prices and for investing in said investing means to match assets and liabilities.

2. The computer system of claim 1, wherein said account value means determines said account value relative to an increase in a stock index and a predetermined participation rate.

5 3. The computer system of claim 2, wherein said account value means determines said account value relative to a predetermined maximum increase rate.

4. The computer system of claim 2, wherein said account value means determines said account value relative
10 to a predetermined minimum increase rate.

5. The computer system of claim 2, wherein said stock index is the Standard & Poor's 500 Index.

6. The computer system of claim 1, wherein said investing means invests in options, and wherein said
15 control means purchases options when sensitivity of said assets to stock price changes is less than sensitivity of said liabilities to stock price changes and sells options when said sensitivity of said assets are greater than said sensitivity of said liabilities.

20 7. The computer system of claim 1, further comprising evaluation means for determining profits from said plurality of insurance policies.

8. The computer system of claim 2, further comprising evaluation means for determining profits from
25 said plurality of insurance policies, and wherein said participation rate is determined relative to said profits.

9. The computer system of claim 2, wherein said participation rate is determined relative to returns on said fixed rate assets.

30 10. An annuity contract computer system that administers a plurality of equity related annuity contracts

on behalf of an insurance company, said computer system comprising:

premium collection means for collecting premiums for each of said plurality of annuity contracts;

5 account value means for determining a respective account value for each of said plurality of annuity contracts, wherein said account value is determined with respect to increases in stock prices; and

10 hedge monitoring means for controlling stock price fluctuation risks, said hedge monitoring means including:

asset determining means for determining the value of assets from said premiums and from investment returns on investments;

15 liability determining means for determining the value of liabilities relative to said account values;

investing means for investing in at least one of fixed rate assets and options; and

20 control means for comparing said assets and liabilities relative to changes in stock prices and for investing in said investing means to match assets and liabilities.

25 11. The computer system of claim 10, wherein said account value means determines said account value relative to an increase in a stock index and a predetermined participation rate.

12. The computer system of claim 11, wherein said account value means determines said account value relative to a predetermined maximum increase rate.

30 13. The computer system of claim 11, wherein said account value means determines said account value relative to a predetermined minimum increase rate.

14. The computer system of claim 11, wher in said stock index is the Standard & Poor's 500 Index.

15. The computer system of claim 10, wherein said investing means invests in options, and wherein said control means purchases options when sensitivity of said assets to stock price changes are less than sensitivity of said liabilities to stock price changes and sells options when said sensitivity of said assets are greater than said sensitivity of said liabilities.

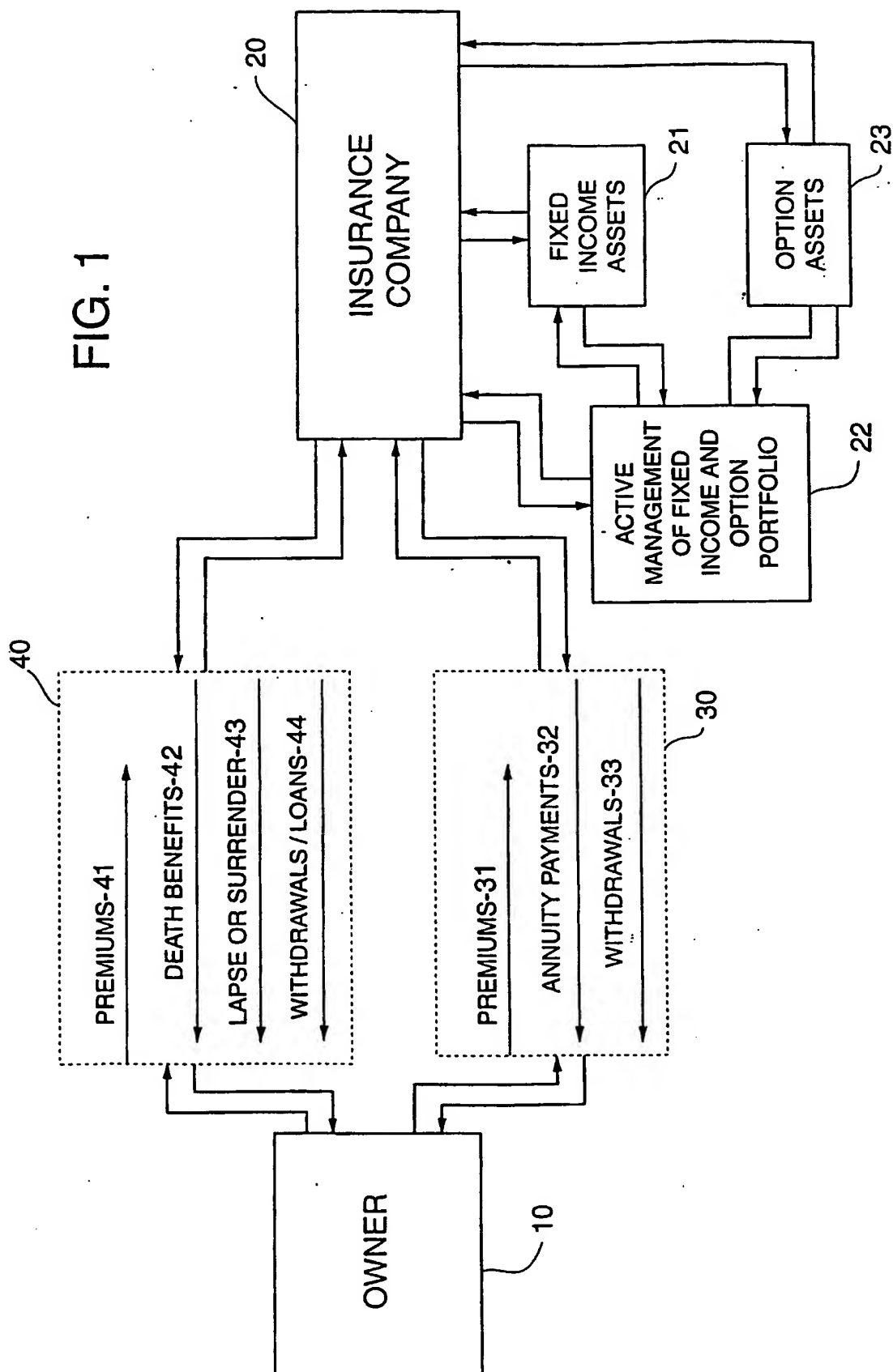
16. The computer system of claim 10, further comprising evaluation means for determining profits from said plurality of annuity contracts.

17. The computer system of claim 11, further comprising evaluation means for determining profits from said plurality of annuity contracts, and wherein said participation rate is determined relative to said profits.

18. The computer system of claim 11, wherein said participation rate is determined relative to returns on said fixed rate assets.

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FIG. 1



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FIG. 2

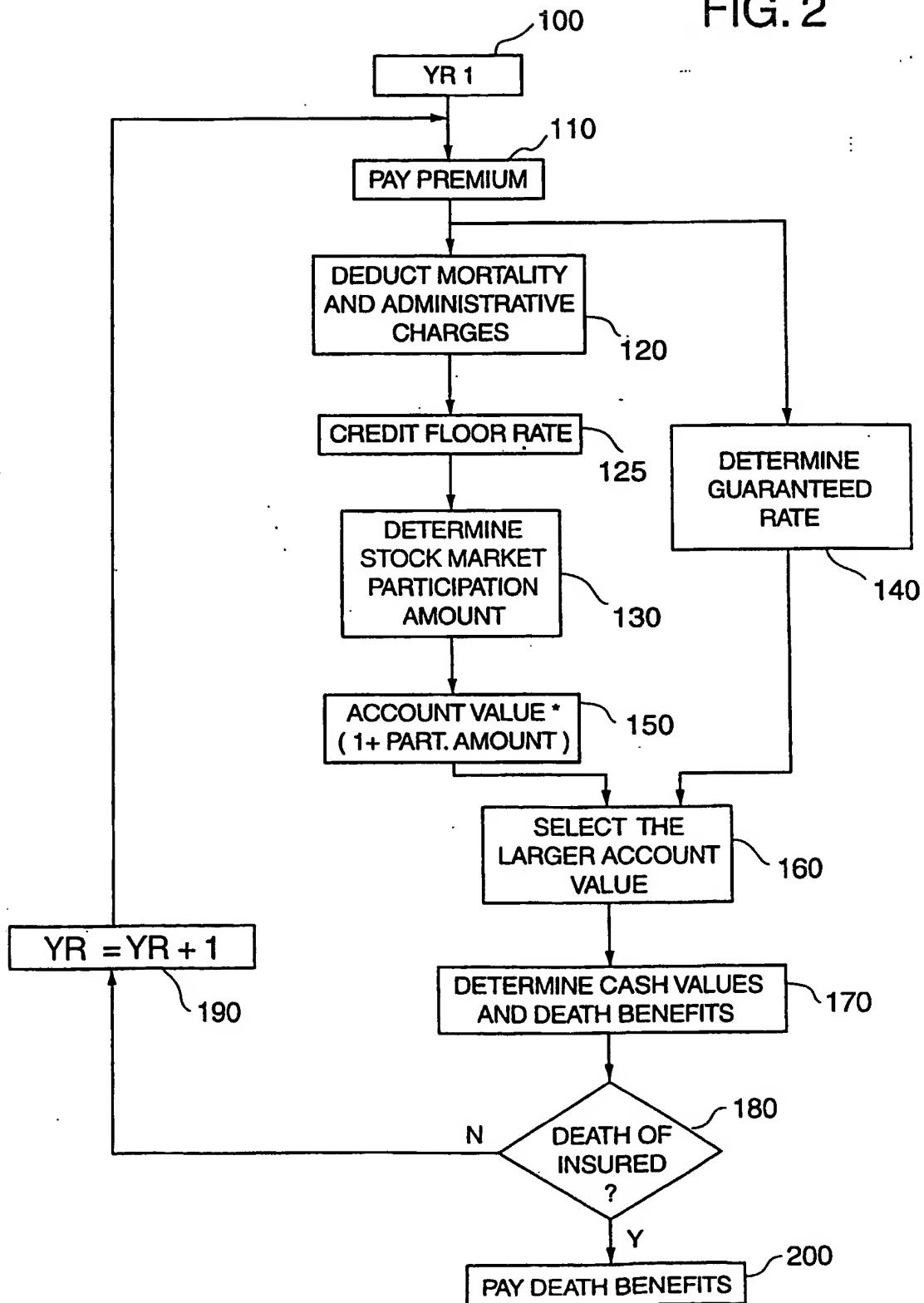
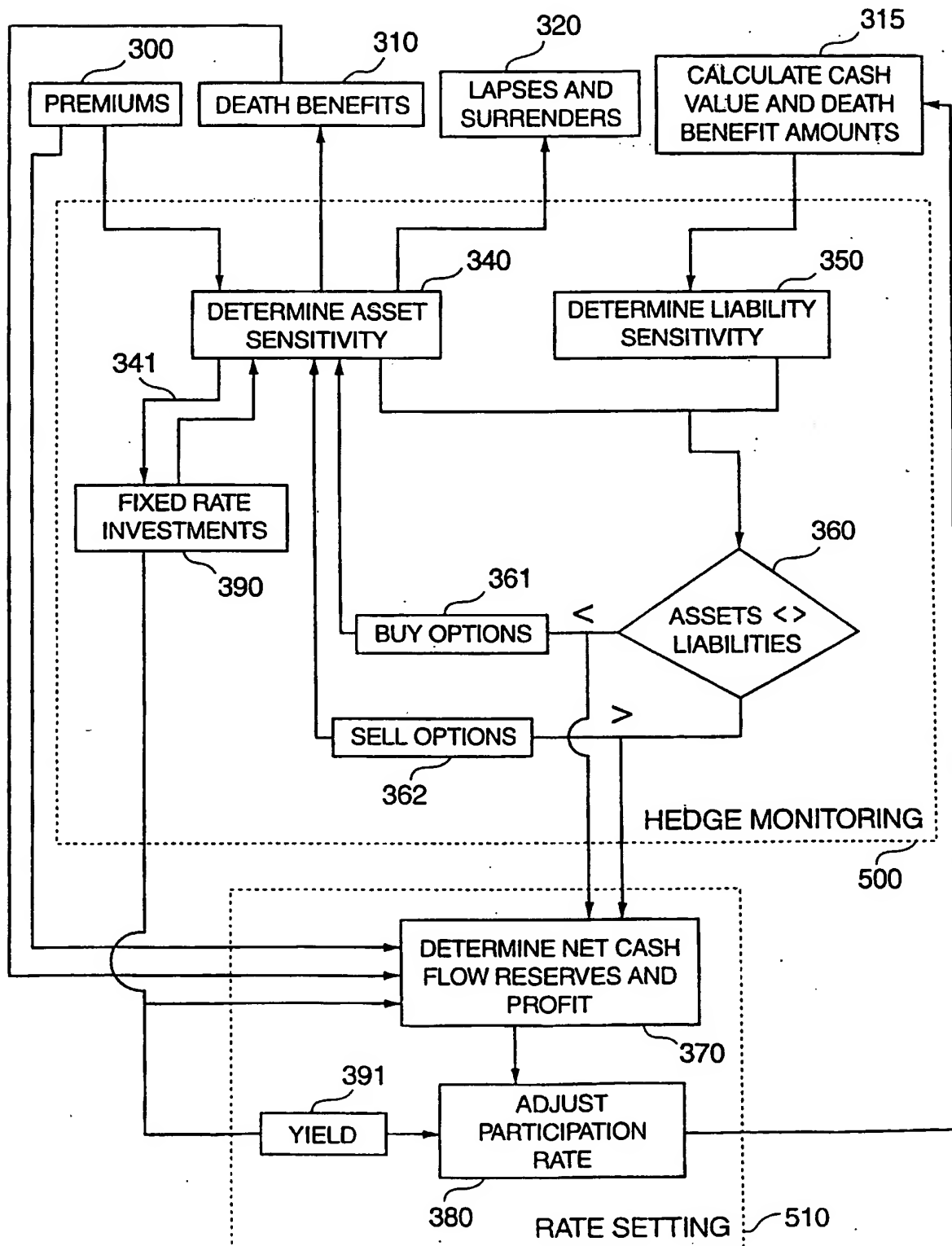


FIG. 3



INTERNATIONAL SEARCH REPORT

International application No.

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A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :G06F 17/60

US CL :705/4

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 705/1, 4, 35-38; 707/10, 100-104

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A,P	US 6,105,865 A (HARDESTY) 22 AUGUST 2000, SEE ENTIRE DOCUMENT.	1-18N
A,P	US 6,052,673 A (LEON ET AL.) 18 APRIL 2000, SEE ENTIRE DOCUMENT.	1-18
Y, P	US 6,049,772 A (PAYNE ET AL.) 11 APRIL 2000, SEE ENTIRE DOCUMENT.	1-18
A	US 4,876,648 A (LLOYD) 24 OCTOBER 1989, SEE ENTIRE DOCUMENT.	1-18



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:	*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
A document defining the general state of the art which is not considered to be of particular relevance	*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
E earlier document published on or after the international filing date	*Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
L document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	*Δ* document member of the same patent family
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P document published prior to the international filing date but later than the priority date claimed	

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